

[Perrin, Sandford] and others  
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CIRCULAR-LETTER ADDRESSED TO ASTRONOMERS OF ALL NATIONS.

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PROPOSED CHANGE  
IN RECKONING THE ASTRONOMICAL DAY.

TORONTO, CANADA, 21st April, 1893.

The Canadian Institute in co-operation with The Astronomical and Physical Society of Toronto, have had under consideration the subject of Astronomical Time Reckoning, and have, after much deliberation and consultation, appointed a Joint Committee to suggest the best means of ascertaining the views of astronomers throughout the world.

The Joint Committee have presented the accompanying Report, in which both Societies concur.

On behalf of the two Societies we have the honour to direct attention to the observations and recommendations of the Joint Committee, as well as to the appended extracts, expressing the views of the following gentlemen :—

1. Sir John Herschell.
2. M. Otto Struvè, Imperial Astronomer, Pulkowa.
3. Mr. W. H. M. Christie, Astronomer Royal, Greenwich.
4. Prof. S. Newcomb, Nautical Almanac Office, Washington.
5. Commodore Franklin, United States Naval Obs., Washington.
6. Mr. C. Carpmæl, President Astronomical Society, Toronto.
7. Mr. Arthur Harvey, President Canadian Institute, Toronto.

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In order to obtain the views of as many astronomers as possible the Joint Committee recommend that answers be invited to the following question :—

Is it desirable, all interests considered, that on and after the first day of January, 1901, the Astronomical Day should everywhere begin at Mean Midnight?

It is requested that early answers to this question be sent to the following address :—

*JOINT COMMITTEE ASTRONOMICAL TIME,*

*CANADIAN INSTITUTE,*

*TORONTO, CANADA.*

As it is intended to send copies of further papers on this subject to those replying, it is desirable that the full name, official designation, if any (professional or non-professional) and proper address be furnished with each reply.

ALAN MACDOUGALL,

G. E. LUMSDEN,

*Joint Secretaries.*

## REPORT OF THE JOINT COMMITTEE

*Of The Canadian Institute and The Astronomical and Physical Society of Toronto.*

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SANDFORD FLEMING, C.E., C.M.G., LL.D., Etc., *Chairman.*

*Canadian Institute.*

ARTHUR HARVEY, President.  
 GEO. KENNEDY, M.A., LL.D.  
 ALAN MACDOUGALL, C.E., Secretary.

*Astronomical Society.*

CHARLES CARPMAEL, M.A., F.R.A.S., Etc., President.  
 JOHN A. PATERSON, M.A.  
 G. E. LUMSDEN, Corresponding Secretary.

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TORONTO April 20th, 1863.

Your Committee on the subject of Astronomical Time Reckoning, beg leave to report as follows:—

(a) That the Sixth Resolution of The Washington International Conference of 1884, which was carried unanimously by the representatives of the twenty-five nations there assembled, counting among them several astronomers of world-wide fame, reads as follows:—"The Conference expresses the hope that, as soon as may be practicable, the Astronomical and Nautical Days will be arranged everywhere to begin at Mean Midnight;"

(b) If any action is to be taken on this Resolution, the most appropriate date for the new reckoning to take effect would be the first day of the new century;

(c) As the Ephemerides are usually prepared four or five years in advance, it is obvious that if it be decided to make Astronomical Time accord with Civil Time at the date named, a common understanding should not be delayed beyond the year 1895 or 1896;

(d) To arrive at an agreement, it is considered essential to ascertain the views of those concerned;

(e) The Canadian Institute and The Astronomical Society should, in the general interest, assume the duty of inviting opinions upon the subject, to be collated, tabulated and published in a special report;

(f) If the weight of opinion expressed by those who respond to such invitation, be in favour of a change, further steps may be taken with the view of reaching an international understanding;

(g) Your Committee suggest that the opinions which have already been expressed by some leading astronomers be published. To this end,

extracts from the writings of Herschell, Struvè, Christie, Newcomb and Franklin, are hereto appended; also, remarks recently made by the President of the Astronomical and Physical Society of Toronto, and the President of the Canadian Institute;

(h) Your Committee recommend that replies be asked to the following question, and that it be widely circulated:—

QUESTION.

Is it desirable, all interests considered, that on and after the first day of January, 1901, the Astronomical Day should everywhere begin at Mean Midnight?

(i) Your Committee further suggest that astronomers generally throughout the world be invited to send definite replies to the question as soon as convenient. Replies to be addressed, "*Joint Committee, Astronomical Time, Canadian Institute, Toronto, Canada.*"

Respectfully submitted,

SANDFORD FLEMING,

*Chairman.*

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## APPENDIX.

### EXTRACTS FROM THE OPINIONS OF ASTRONOMERS AND OTHERS REFERRED TO BY THE JOINT COMMITTEE.

I. (935) Astronomical time reckons from noon of the current day ; Civil, from the preceding midnight, so that the two dates co-incide only during the earlier half of the Astronomical and the later half of the Civil Day. This is an inconvenience which might be remedied by shifting the astronomical epoch to co-incidence with the civil. (147) . . . This usage has its advantages and disadvantages, but the latter seem to preponderate ; and it would be well if, in consequence, it could be broken through and the Civil reckoning substituted. Uniformity in nomenclature and modes of reckoning in all matters relating to time, space, weight, measures, etc., is of such vast and paramount importance in every relation of life as to outweigh every consideration of technical convenience or custom. The only disadvantage to astronomers of using the Civil reckoning is this—that their observations being chiefly carried on during the night, the day of their date will, in this reckoning, always have to be changed at midnight, and the former and latter portions of every night's observations will belong to two differently numbered civil days of the month. There is no denying this to be an inconvenience. Habit, however, would alleviate it ; and some inconveniences must be cheerfully submitted to by all who resolve to act on general principles. All other classes of men, whose occupations extend to the night as well as day, submit to it, and find their advantage in so doing.—*Sir John Herschell's Treatise on Astronomy—Third Edition.*

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II. Much earnest reflection, on the other hand, must be given to the desire expressed at the meeting, that Astronomical Time Reckoning should be brought in accord with the commencement of the day in civil life. In this matter, astronomers have not simply to abandon a custom of long standing, and consequently to make conditional changes of practice established for many years, but, at the same time, astronomical chronology is disturbed, which is easily understood, must exercise a marked effect on the comprehension of all problems bearing upon matter. Without doubt, the astronomer must make a great sacrifice for the fulfilment of this desire ; but, in reality, this sacrifice is not greater than that entailed on our forefathers when they passed from the Julian to the Gregorian Notation of Time, or when they altered the commencement of the year : a sacrifice of convenience by which we yet suffer when it becomes necessary to refer to phenomena of remote dates. At this period, we must the less stand in fear of a like sacrifice, when by such means an acknowledged existing non-accord between science and ordinary life can be set aside : a non-accord which, it is true in individual cases, does not press heavily on the astronomer, but which is a constant source of inconvenience for non-professional astronomers who are desirous of making use of astronomical information. And in such respect, this sacrifice ceases so to be considered and is transformed into an act of public utility with regard to all astro-

nomical details which stand in clear relationship with the outer world in which almost daily conflicts come to the surface between the different designations of dates. Conflicts among others which are even injurious to astronomical labours in such observatories where observations are continually adjusted to the day. . . . While the Directors of the Pulkowa Observatory make their full acknowledgment to the Astronomer Royal for this precedent, which has been established, so are they ready to follow the example, and this fact leads us the more to expect that also this course will be adopted by the Washington Naval Observatory, as in the American Marine the Date Notation from midnight has been already accepted. It is only in the matter of the period when the Date Notation, according to Universal Time, should be introduced into the publications of the observatories, that we feel inclined to recommend that there should be delay until, in this respect, the most perfect possible understanding be attained by all astronomers, in order to avoid the much more critical disturbance in astronomical chronology which would arise if the transition to the new Date Notation was not equally followed on all sides. We are desirous, accordingly, of suggesting a suitable time-point for the commencement of the year for which the Nautical Almanac would inaugurate the changes corresponding to the requirements named. The latter, as has before been said, could come to pass in the year 1890. We would, however, ourselves prefer the change to take place, in the first instance, with the change of the century. Until that date it would probably be the simultaneous proceeding of all astronomers, with general consent, to look forward to this period of transition, and it would more easily stamp itself on the memory of all who hereafter would be busied in investigations in which exact chronology plays a part.—*Paper on the Washington Conference by Otto Struve, Director of the Imperial Astronomical Observatory, Pulkowa, Russia.*

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III. The reasons for making the change, as affecting astronomers, are:—(1) The introduction of the Universal Day commencing at Greenwich Midnight, and reckoning from 0 to 24 hours makes it inexpedient to have another time reckoning of 0 to 24 hours starting from Greenwich Noon. There are already frequent mistakes of date arising from confusion between civil and astronomical reckoning, several practical observers using the former, which is also commonly employed in almanacs and occasionally in some astronomical periodicals. The use of *three* different systems of reckoning solar time would greatly increase the confusion. (2) The circumstances under which astronomical observations are made have completely changed in modern times since the application of powerful telescopes to meridian instruments and the development of Solar Physics. The change of date at noon in the middle of the day's work has thus, in many cases, become very inconvenient. (3) As regards meridian observations, the experience of the past year at Greenwich Observatory (where observations are carried on as continuously through the 24 hours as at any other observatory) shows that the whole of the astronomical day can be introduced very easily and with decided advantage on the whole. (4) In the case of extra-meridian observations, the observer usually finds it convenient to work in the earlier hours of the night, so that little or no inconvenience would result from a change of date at midnight. Discoverers of comets and observers of meteors, who observe in the early morning, often use civil reckoning, and mistakes of date have, on several occasions within my own

knowledge, resulted from the existence of two different modes of counting time. (5) For spectroscopic and photographic observations of the sun, it is now recognized that the day should be reckoned from midnight, and the same reckoning would naturally be used by the observer when he takes spectroscopic and photographic observations at night, and also in determinations of the places of comets, stars, etc., which he may make in connection with his spectroscopic observations. It seems absurd to expect the same observer to change his system of reckoning mean solar time according to the class of observations he is making at the moment. (6) The proposal to include in the routine work of an observatory, photography of the stars, as well as of the sun, will further increase the difficulty of maintaining a distinction as regards time-reckoning between the various classes of astronomical observations. (7) At many observatories, magnetical and meteorological observations are carried on concurrently with astronomical observations, and it is admitted that for the two former classes the day commencing at midnight should be used. (8) For the distribution of the time to the public, a work which is undertaken by many observatories, the civil day would be used. (9) Thus civil reckoning commencing at midnight must be used for solar, magnetical, and meteorological observations, and also for the distribution of time to the public, so that the retention of astronomical reckoning would involve the use of two different systems of mean solar clocks, differing by 12 hours, in the same observatory—a circumstance likely to lead to intolerable confusion. (10.) As regards the supposed discontinuity which would arise from the change in the Nautical Almanac, the difference of time-reckoning is precisely similar to that which would have to be taken into account in the comparison of Greenwich observations with those made at any other observatory. The astronomical calculator is in the habit under the present system of allowing for the difference in time-reckoning between different observatories, and his task would be greatly simplified if he had only to deal with universal time.—*Report to the Trustees of Greenwich Observatory, by W. H. M. Christie, M.A., LL.D., Astronomer Royal of England.*

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IV. The first of these recommendations proposes a change in the method of counting astronomical time which has come down to us from antiquity, and which is now universal among astronomers. The practice of taking noon as the moment from which the hours were to be counted originated with Ptolemy. This practice is not, as some distinguished members of the Conference seem to have supposed, based solely upon the inconvenience to the astronomer of changing his day at midnight, but was adopted because it was the most natural method of measuring solar time. At any one place solar time is measured by the motion of the sun, and is expressed by the sun's hour angle. By uniform custom, hour angles are reckoned from the meridian of the place, and thus by a natural process the solar day is counted from the moment at which the sun passes over the meridian of the place or over the standard meridian. . . . A change in the system of reckoning astronomical time is not merely a change of habit, such as a new method of counting time in civil life would be, but a change in the whole literature and teaching of the subject. The existing system permeates all the volumes of ephemerides and observations which fill the library of the astronomer. All his text-books, all his teachings, his tables, his formulæ, and his habits of calculation are based on this system. To change the system will involve a change in many of the

precepts and methods laid down in his text books. . . . But this would only be the beginning of the confusion. Astronomical observations and ephemerides are made and printed not only for the present time, but for future generations and for future centuries. If the system is changed as proposed the astronomers of future generations who refer to these publications must bear the change in mind in order not to misinterpret the data before them. The case will be yet worse if the change is not made by all the ephemerides and astronomers at the same time epoch. It will then be necessary for the astronomers of the twentieth century, using ephemerides and observations of the present, to know, remember, and have constantly in mind a certain date different in each case at which the change was made. For example, if, as is officially announced, the Naval Observatory introduces the new system on January 1, 1885, then there will be for several years a lack of correspondence between the system of that establishment and the system of the American Ephemeris, which is prepared four years in advance. . . . I see no advantage in the change to compensate for this confusion. If astronomical ephemerides were in common use by those who are neither navigators nor astronomers the case would be different. But, as a matter of fact, no one uses these publications except those who are familiar with the method of reckoning time, and the change from astronomical to civil time is so simple as to cause no trouble whatever. The change will affect the navigator as well as the astronomer. Whether the navigator should commence his day at noon or midnight, it is certain that he must determine his latitude from the sun at noon. The present system of counting the day from noon enables him to do this in a simple manner, since he changes his own noon into the astronomical period by the simple addition or subtraction of his longitude. To introduce any change whatever into the habits of calculation of uneducated men is a slow and difficult process, and is the more difficult when a complex system is to be substituted for a simple one. I am decidedly of the opinion that any attempt to change the form of printing astronomical ephemerides for the use of our navigators would meet with objections so strong that they could not be practically overcome. . . . I respectfully submit that in view of these considerations no change should be made in the change of reckoning time employed in the publications of this office until, by some international arrangement, a common date shall be fixed by all nations for the change.—*Argument against changing the Astronomical Day, by Prof. S. Newcomb, LL.D., Etc., Superintendent of the Nautical Almanac Office, Washington, Dec. 6, 1884.*

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V. Referring to the letter of Professor Newcomb, concerning the resolution of the late International Meridian Conference on the subject of the change of the astronomical date, so as to make the midnight of Greenwich 0 hours, instead of noon as at present, I have the honor to submit the following considerations. . . . The order referred to was not issued without a knowledge on my part of the views of such a distinguished astronomer as Professor Adams, of England, as well as of those of other members of the Conference. A reference to the proceedings of the Conference shows that its recommendation on this point was unanimous. It has been publicly announced in *Nature* that the Astronomer Royal of England proposes to make the change on the same date as that directed by me; this has been confirmed by a telegram received from him by me. So far as the counting of astronomical time from antiquity is concerned, it is the argument of conservatism which desires no change in an existing

order of affairs ; yet, assenting to this argument, we might refer to a still remoter antiquity—to the time, not of Ptolemy, but of Hipparchus, the “ Founder of Astronomy,” who reckoned the twenty-four hours from midnight to midnight, just as the Conference has proposed. While it is unquestionably true that some confusion may occur, yet the liability to it will be almost entirely with the astronomer, who, through his superior education and training, could easily avoid it by careful attention to the ephemerides he was using. During the years of change, before the ephemerides are constructed in accordance with the new method, it will only be necessary to place at the head of each page of recorded observations the note that the time is reckoned from midnight, to call attention to the fact, and thus obviate the danger of error. It is an undeniable fact that the educated navigator finds the conversion of time a simple matter, yet experience has demonstrated that to the mariner who is not possessed of a mathematical education there is a decided liability to the confusion which is so greatly deprecated by all who are interested in this subject. I believe that to all navigators, at least to all English-speaking ones, the new method will prove itself decidedly advantageous. As is well-known, for many years navigators kept sea time, by which the day was considered to begin at noon, preceding the civil day by twelve and the astronomical day by twenty-four hours. The change to civil time now kept on board ship was effected readily and without friction, so that the recommendation of the Conference regarding the commencement of the nautical day has already been largely anticipated. The navigator is concerned not with his longitude but with his Greenwich time, having obtained which he can take from the Nautical Almanac the data he seeks, whether given for noon or midnight, and when the ephemerides shall have been made to conform to the new system there will be one time in common use by all the world. It seems to me eminently proper that the nation which called the Conference should be among the first to adopt its recommendations, and while it might possibly be better to wait until an entire agreement has been entered into by the astronomers of all nations, yet the fact that the first and most conservative observatory in the world has acceded to this proposal of the Conference would seem to be a sufficient reason why we should not wait for further developments. In deference, however, to the views so well advanced by Professor Newcomb, and in view of the fact that the President has recently transmitted the proceedings of the Conference to Congress, as well also of the desirability of securing uniformity among the astronomers of our own country at least, I have suspended the execution of the order for the present.—*Remarks by Commodore S. R. Franklin, Superintendent United States Naval Observatory, Washington, Dec. 11th, 1884.*

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VI. The subject of reform in time-reckoning was brought before the Canadian Institute many years ago by Mr. Sandford Fleming. The reforms suggested were much needed, and were so ably advocated by Mr. Fleming that already several of them have been adopted not only on this continent, but in various countries all over the world. One important suggestion, however, although recommended by the Washington Conference, has not yet been acted upon, viz., the making of the astronomical and nautical day to accord with the civil day. It has been suggested that a body like this Society may render valuable assistance in this matter by collecting the opinions of astronomers on the subject. The Canadian Institute having been the first society to

bring the whole subject prominently and successfully before the world, it would be well for us to ask their co-operation with us in this matter. As an illustration of some of the inconveniences which result from the present want of accord between the astronomical and nautical day and the civil day, I may refer to a case within my own experience. In 1873 a sudden and very violent storm caused great destruction along the south-eastern coast of Nova Scotia. I had occasion to investigate that storm, and, for the purpose, obtained the logs of vessels which were caught in it. I was assisted in this by the late Sir Henry Lefroy, then Governor of the Bermudas, who procured the logs, or copies of the logs, of the ships which put into the islands for repairs. The satisfactory examination of these logs was attended by great difficulty owing to a want of uniformity among the sea captains in making entries. For instance, many of the captains wrote up their logs at noon for the twenty-four hours. Some of them were accustomed to enter up the events occurring between, say, noon of the 20th of the month and noon of the 21st, under the date of the 20th; that is, the astronomical and nautical day during which they happened, while others entered the same events under date of the 21st, or that upon which the entries were made, so that, in the absence of specific information, it was impossible to tell to which set of twenty-four hours any given event should be referred. Had the captains been in the habit of changing their dates at midnight, no such inconvenience would probably have resulted. For my part I am decidedly in favour of bringing Astronomical Time into harmony with civil reckoning at the change of the century. After considering all that can be said against any alteration in the present dual system, I am satisfied that any inconvenience which would result to individuals from the change would be limited in duration and would not be felt by a large number of persons. If it be determined once for all to abandon the double notation of dates at the beginning of the new century, ample time would be allowed for any necessary preparation for the change, and when the period of transition arrived any inconvenience which might temporarily be felt could not be compared with the advantages which would follow in all future years from uniformity of reckoning.—*Remarks to the Astronomical and Physical Society of Toronto, by Charles Carpmael, Esq., Superintendent of the Meteorological Service of Canada, February 11th, 1893.*

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VII. The Canadian Institute, which took the initiative in bringing before the Scientific world, in 1879, the principle of Universal Time Reckoning, heartily co-operates with its sister society in the endeavor to bring the Astronomical day within the sphere of uniformity it has continuously advocated. The Council of the Institute approves of the terms of the Circular Letter prepared by the Joint Committee under the Chairmanship of Mr. Sandford Fleming, long identified with this subject, and an honorary member of both societies. It is not easy for me to conceive any reason for beginning the day at noon, other than the convenience of having all the hours of darkness brought within one astronomical day. Stellar observations for the purpose of practical astronomy no longer requiring darkness, this reason no longer exists, and I trust we are now warranted in expecting the abolition of a double notation of date as the result of our efforts.—*Arthur Harvey, Esq., President of the Canadian Institute, Toronto, April, 1893.*

*While replies may be in any form, the following, if found convenient, may be filled up and returned by post.*

*To the Joint Committee on Astronomical Time,  
Canadian Institute, Toronto, Canada.*

In reference to the circular-letter addressed to Astronomers of all Nations, dated April 21st, 1893, and in reply to the question therein submitted, the undersigned is \* in favour of the Astronomical Day being changed so as to begin at mean midnight on and after the close of the present century.

*Signature*.....

*If the person replying is officially }  
attached to an Observatory, please }  
give the name of the Observatory. }*.....

*Post Office Address*.....

*\* The word NOT written in this blank will indicate that the person replying is opposed to a change.*

